

REMARKS

Claims 1-10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Borrell et al. (US Pat. No. 6,690,485) in view of Allen et al. (US Pat. No. 5,633,662) in further view of Hudson et al. (US Pat. No. 6,042,211).

Claims 2, 3 and 6 have been cancelled.

Turning now to Borrell et al, as has been previously pointed out, Applicants believe that the Examiner has misinterpreted the Borrell et al. reference when he states that Borrell et al disclose the use of a code value having a nonlinear relationship to colorant amount in column 8, lines 43-51 and column 10, lines 16-31. Claim 1 of the present invention has been amended to more clearly distinguish the difference between the nonlinear function used in the present invention and that referred to in Borrell et al. In particular, the term "colorant amount" has been changed to "colorant volume" to make it clear that the nonlinear relationship as discussed in the present invention exists between the input code value and a physical volume of ink (the amended wording is supported on page 7, lines 3-5 of the specification).

As set forth in amended Claim 1, the present invention is applicable where there is nonlinear relationship between input code value and colorant volume, where it is used to determine modified colorant volumes such that the sum of the modified colorant volumes is less than a total colorant amount limit. The type of nonlinear relationship required in the present invention is very different from the nonlinear relationship described in Borrell et al, which relates the input code value to perceived intensity of the printed dot pattern. The perceived intensity relates to how dark an image patch appears to be, and is not a measure of the volume of ink that was applied to the page. In fact, the embodiment described by Borrell et al. implies a linear relationship between input code value and colorant volume, even though there is a nonlinear relationship between input code value and perceived intensity. For example, column 2, lines 53-56 notes that a 0.5 input intensity (i.e., a 50% input code value) maps to a checkerboard pattern where 50% of the pixels will be turned on (i.e., a 50% colorant volume). The nonlinearity that Borrell et al describe results from the fact that the perceived intensity level will generally not vary linearly with input code value due to the fact that round dots are printed on a square grid. Applicants fail to see how Borrell et al teaches modifying an input digital image where the input

code value has a nonlinear relationship to colorant volume, and therefore do not see how Borrell et al disclose or suggest step a in amended Claim 1.

Additionally, as has been previously pointed out, Borrell et al. is concerned with adding additional colorant in order to increase color saturation or improve color intensity linearity, whereas the present invention is concerned with removing colorant volume to satisfy a colorant amount limit in order to prevent image artifacts from occurring. By this amendment, the claims have been changed to improve their form and to remove any possible ambiguity. Claim 1 now sets forth that the invention is directed to ensuring that modifications to the colorant volume for each color channel corresponding to a pixel are made when a total colorant amount limit has been exceeded. This will happen when the sum of the input colorant volumes exceeds the total colorant amount limit. Furthermore, element (b) now requires that the sum of the modified colorant volumes for each color channel is less than the total colorant amount limit. These changes more clearly point out differences between the cited references and the invention set forth in claim 1.

Applicants also feel that there may be some ambiguity regarding the term "depletion" as referenced in the present invention and Borrell et al. As used in the present invention, the term "depletion" refers to the process of removing ink volume to prevent undesirable artifacts from occurring (see page 8, lines 1-3). This involves the use of a total colorant amount limit, which is selected to provide for acceptable image quality for a given ink and media combination (see page 7, lines 29-31). The term "depletion" as referred to by Borrell et al is directed towards addressing problems of color intensity linearity. Applicants can find no reference to total colorant amount limit in any of citations from Borrell et al. In col. 7, lines 22-52, Borrell et al do discuss the problem of depletion using a total colorant amount limit to remove ink and prevent image artifacts from occurring. However, immediately thereafter, starting at col 7, line 53, they state that these types of depletion methods do not address problems of color intensity linearity, which is the subject of their invention. Please note that in col. 8, lines 36-39, Borrell et al state "In the process of implementing the present invention a strong functional relationship to the depletion process has been discovered. The invention, however, has opposite objectives and opposite effect." Clearly Borrell et al teach away from the present invention and do not use a total

colorant amount limit to prevent artifacts. Applicants fail to see how Borrell et al. is relevant with respect to the subject matter of Claim 1 which pertains to a method of reducing colorant volumes subject to a total colorant amount limit. As previously noted, the Borrell et al process may actually increase the colorant volumes so as to exceed the colorant amount limit and produce artifacts.

As understood by Applicants, Allen et al. do not disclose a method of determining an input colorant volume for each color channel of a pixel wherein the input code value has a nonlinear relationship to the colorant volume as required by the present invention. Applicants have recognized that by using this nonlinear relationship, improved images can be produced. As pointed out on page 6 of the application, an advantage of the present invention is that the maximum volume of colorant is more accurately controlled for a multilevel printer, does not use excess colorant volume, and produces aesthetically pleasing images free from artifacts. Applicants believe they are the first to use this nonlinear relationship in controlling the volume of colorant that is deposited for a pixel. Clearly, there is no motivation in Allen et al. for this claimed subject matter, which is set forth in claim 1. Allen et al. use a linear relationship. Consequently, Applicants fail to see how Allen et al can be combined with Borrell et al to be relevant to the present invention since neither reference makes use of the fact that an input code value has a nonlinear relationship to colorant volume.

It is true, as the Examiner states, that Hudson et al. disclose determining an output code value for each color channel of the pixel responsive to the modified colorant amount and an inverse colorant amount function. However, what Hudson et al. are concerned with is compensating for ink drop volume variations rather than reducing total colorant amount subject to a total colorant amount limit. A particular cartridge may produce an ink drop volume that is larger or smaller than a desired amount. The method of Hudson et al. modifies the code values to compensate for this variation and preserve accurate color. Applicants can find nothing in Hudson et al. which relates to the nonlinear relationship between input code value and colorant volume as discussed above, nor to the way that Claim 1 makes use of such a relationship.

It is believed that these changes now make the claims clear and definite and, if there are any problems with these changes, Applicants' attorney would appreciate a telephone call.

In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

Respectfully submitted,



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If the Examiner is unable to reach the Applicant(s) Attorney at the telephone number provided, the Examiner is requested to communicate with Eastman Kodak Company Patent Operations at (585) 477-4656.